UNIVERSITI TEKNOLOGI MARA

SYNTHESIS OF REDUCED GRAPHENE OXIDE-SILVER NANOHYBRIDS: USING MONOSACCHARIDES AS REDUCING AGENTS AT DIFFERENT TIME REACTION

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ABSTRACT

Silver nanoparticles (AgNPs) were incorporated on the rGO sheets to create a reduced graphene oxide-silver (rGO-Ag) nanohybrid. This nanohybrid was created to improve the electrical conductivity of both materials, implying that it has several uses in diverse fields. This study demonstrated a simple synthesis of Reduced Graphene Oxide Silver (rGO-Ag) nanohybrids employing different monosaccharides (Galactose, Ribose, and Fructose) as reducing agents and at various reaction times (4h, 8h, 16h, and 24h). Ultraviolet-visible (UV-vis) Spectroscopy, X-Ray Diffraction (XRD), High Resolution Transmission Electron Microscopy (HR TEM), and Raman Spectroscopy were used to confirm the morphological and structural properties of the rGO-Ag nanohybrid. According to the UV-Vis analysis, galactose was the most efficient reducing agent. The largest peak detected by the rGO-Ag reduced with galactose [rGO-Ag (Gal)] at 271 nm corresponded to the creation of silver nanoparticles (AgNPs) on the rGO, while the narrowest peak observed at 423 nm belonged to the formation of silver nanoparticles (AgNPs) on the rGO. Attributing to the XRD inquiry, rGO-Ag (Gal) showing the amorphous crystallinity at peak 24.5° proving the succession of rGO convesion and recorded the smallest particle size 6.50 nm of AgNPs anchor on the rGO sheets. by using FWHM value obtained. was used to analyse the nanohybrids obtained with the other reducing agents. The samples' oxygen and carbon contents were also determined using a FESEM fitted with an energy-dispersive X-ray (EDX). In comparison to the other two monosaccharides, the average particle size determined from the rGO-Ag (Gal) XRD data was the smallest (6 nm). Furthermore, the rGO-Ag (Gal) d-spacing was nearly equal to the XRD data, corroborating the high-resolution transmission electron microscopy (HRTEM) findings. As a result, galactose was the perfect reducing agent for the production of rGO-ag nanohybrids. This research was then carried on by characterisation of nanohybrid at different time reactions using galactose as a reducing agent. On the UV-Vis study, the rGO-Ag (16h) showed the best result due to its intense peak of creation monodispersed spherical silver nanoparticles onto the rGO sheets. The predicted crystallite size of rGO-Ag (16h) in XRD analysis was the smallest 11.83 nm, which was also verified by HR TEM pictures of rGO-Ag (16h) and the histogram displayed confirming the particles size of monodispersed silver nanoparticles was 11 nm. According to the raman analysis, the ratio of D band to G band of the rGO-Ag nanohybrid was the highest, indicating the formation of the smallest crystallite size. The study went on to investigate the electrical behaviour of the nanohybrid using a two-point probe. The I-V curve was plotted based on this data analysis, and rGO-Ag (16h) had the lowest resistance value of 68.82 Ω and the maximum conductance value of 14.52 10^{-3} sm^{-1}. As a result, rGO-Ag, which was synthesised using galactose as a reducing and stabilising agent and at an ideal 16h reaction time, demonstrated the best electrical conductivity qualities, making it suitable for use in any electrical device.

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CHAPTER 1
INTRODUCTION

1.1 Background of Study

Graphene is a single layer of carbon atoms arranged in a two-dimensional honeycomb lattice structure. It is an exceptional material with remarkable properties including high electrical and thermal conductivity. Graphene has various potential applications such as electronics, material science and more due to its properties (Torres et al. 2020). Although graphene exhibits an exceptional electrical conductivity property, graphene can be challenging to produce and work in large quantities due to its easy to agglomerate. Graphene easily agglomerate because the graphene sheets are bond together by strong van der waals forces where these forces cause the graphene sheets to be attracted to each other (Lu et al. 2019). Besides, in producing large quantities of graphene could be very expensive. Therefore, Reduced Graphene Oxide (rGO) are preferable compared to graphene because its is easily to be handle to integrate into various application, more scalable and cost-effective.

rGO is a form of graphene that was derived from Graphene Oxide (GO) through a reduction process. GO are made from graphite and undergo chemical modification to consist oxygen-containing functional group on its surface cause GO to easily dispersed in a solvent. After GO undergo reduction process rGO was created by removing some of the oxygen functional group and partially restored the electrical conductivity of the material. As a result, rGO has improved electrical conductivity compared to GO but still not as conductive as graphene (Carrales-Alvarado et al. 2020). rGO still remains the remarkable properties of graphene such as mechanical strength, high electrical conductivity and high surface area but also being more processable and cost effective than graphene. While rGO consist a lot of advantages it also has certain limitations when using it in various application. Even though electrical conductivity of rGO improved that GO but it still not highly as graphene which can limit its suitability for applications required high electrical conductivity. Like other forms of graphene rGO can agglomerate due to poor dispersion in solvent which this issue can be overcome by incorporating rGO with metal nanoparticles such as silver nanoparticles. (X. Guo et al. 2021)